Shuttle Technology for Earth Laboratories

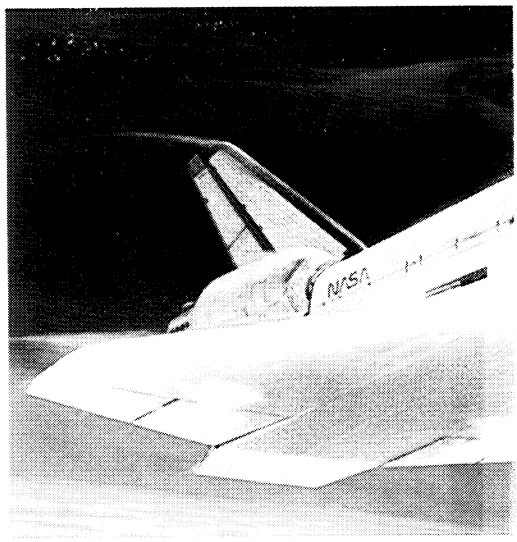
An analytical system that incorporates Space Shuttle thermal tiles heads a sampling of spinoff advances in industrial productivity and manufacturing technology

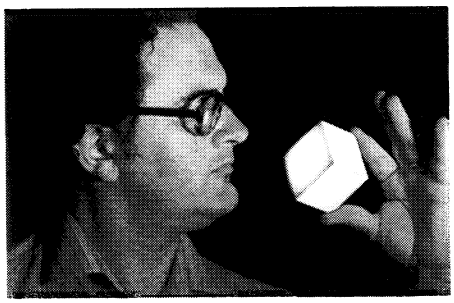
In the first decade of U.S. space flight, protection of manned spacecraft from the searing heat of re-entry was provided by heat shields made of material that literally burned away. The burning dissipated the energy of atmospheric friction as the spacecraft plunged Earthward and thus reduced heat buildup on the spacecraft itself. The heat shields on Mercury, Gemini and Apollo spacecraft performed flawlessly—but they were good for only a single flight.

With the advent of the reusable Space Shuttle, there was need for a new system to protect the Orbiter and its occupants from re-entry temperatures as high as 2300 degrees Fahrenheit. NASA sought a material that could withstand heat greater than that of a blast furnace yet survive repeated heating and cooling without need for replacement. Years of research provided an answer: the "thermal tile," developed for NASA by Lockheed Missiles & Space Company. Made of a silica fiber insulating material, the tiles cause heat on their surfaces to dissipate rapidly while heat transfer to the inner areas of the tiles is extremely slow, the key to repeated-use Shuttle shielding. The material is cut and formed in some 34,000 shapes and sizes to fit the Orbiter's contour.

The extraordinary insulating characteristics of the tiles led to their use in a recently introduced spinoff application, the Pyran™ System produced by Ruska Instrument Corporation, Houston, Texas, a company which has been engaged for more than 50 years in the manufacture of precision pressure calibration instruments and petroleum reservoir fluid analyzers. Ruska states that the PYRAN System represents a major advancement in control of pyrolysis, the technology of subjecting organic materials to selected temperatures to break them down into their component parts, and that the system offers capabilities hitherto unavailable.

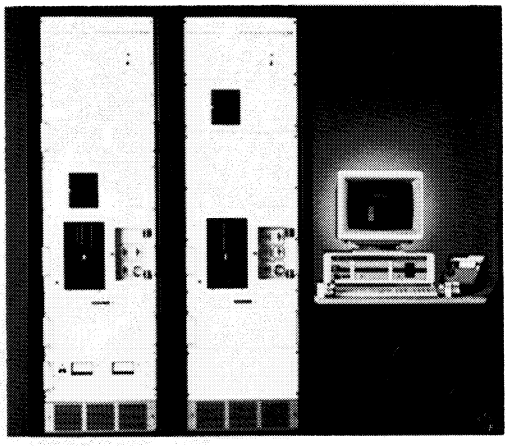
The PYRAN System is designed for rapid, automated analysis of the composition of organic matter. It is capable of heating samples to 1130 degrees Fahrenheit with infrared heat at a precisely controlled rate in a carefully controlled atmosphere. In order to do this with the degree of control and repeatability desired, the developers of the PYRAN System decided they would need a special type of material to insulate the heating chambers. Ruska scientists conferred with Lockheed and Johnson Space Center thermal experts and these consultations resulted in Ruska's adoption of Space Shuttle tiles for the difficult insulating job. Purchased from Lockheed, the tiles provide the superior insulating characteristics needed and they can be readily cut and formed to fit the heating chambers.



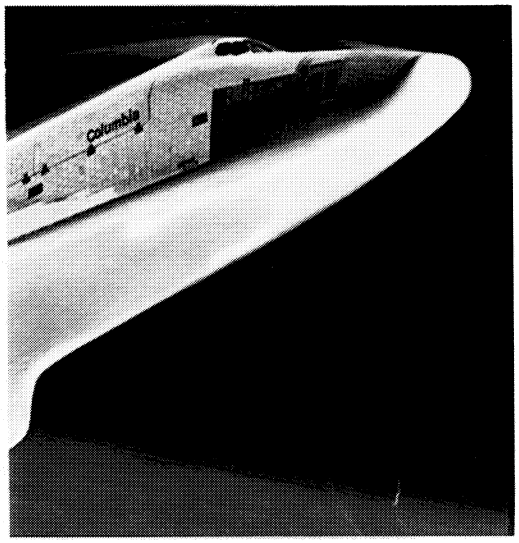


Ruska's first PYRAN System sales were to petroleum industry laboratories for analysis of geochemical samples. The company has since found broadening interest among general analytical laboratories for analysis and quality control of such things as forensic evidence, polymers, catalysts, chemical warfare agents, tobacco products, cosmetics, pharmaceuticals and foods.

An interesting sidebar: the PYRAN System, which did not exist at the time NASA's Apollo astronauts acquired samples of moon rock and soil, was recently used to check those samples. They are stored in special airtight containers; the PYRAN System was used to ensure that the lunar material was not being contaminated by organic material used in the storage process. ▲



Among spinoff applications of the Shuttle tile material is the Pyran System (above), a high temperature system for laboratory analysis of organic materials. The tile material provides the superior insulation characteristics essential to protection of the system's fused quartz components (below).



An artist's concept shows how the underside of the Space Shuttle Orbiter heats up to more than 2,000 degrees Fahrenheit during re-entry. The temperature of the aluminum airframe however, never exceeds 350 degrees, due to a protective system—a thin glass skin supported by silica fiber tiles—that dissipates more than 90 percent of the heat energy. The rapid dissipation of heat from the tile's surface is illustrated at left, where an engineer is holding barehanded a tile removed only seconds earlier from oven heat of 2400 degrees.